

## What is Claimed is :

1. Method for improving a high-speed edge-coupled photodetector based on the compound semiconductor substrate comprising the following processes:
  - 5 a) forming a coupling facet of said photodetector by the etching process;;
  - b) providing said coupling facet with edges of an absorption layer and of layers above;;
  - c) forming a chemically etched, crystallographically defined semiconductor slope right in front of and below said coupling facet;
  - 10 d) coating said coupling facet with an antireflective dielectric film'
  - e) covering said semiconductor slope with a highly reflective metal film and a thick dielectric layer followed by a planarization process;
  - f) providing an optical funneling effect in the vertical direction with said thick dielectric layer together with its sloping bottom and planarized top; and
  - 15 g) forming the top view of said planarized dielectric layer into a proper funnel shape so as to provide said optical funneling effect in the lateral direction.
2. The method of claim 1, wherein said coupling facet further comprises an edge of layers which is below the absorption layer and provides optical guiding.
- 20 3. The method of claim 1, wherein said semiconductor slope has a rising angle smaller than  $45^{\circ}$ .
4. The method of claim 1, wherein said planarization process for said thick dielectric layer is a polymer spin-on process, followed by thermal curing and overall etching-back to uniformly expose the top of said photodetector.
- 25 5. The method of claim 1, wherein said planarization process for said thick

dielectric layer is a conformal deposition process, followed by dielectric polishing and overall etching-back to uniformly expose the top of said photodetector.

6. The method of claim 1, wherein said planarized dielectric layer has its top covered by highly reflective metal film or left uncovered.
7. Method for improving a high-speed edge-coupled photodetector based on the compound semiconductor substrate comprising the following processes:
  - a) Forming a coupling facet of said photodetector by the etching process;
  - b) Providing said coupling facet with edges of an absorption layer and of layers above;
  - c) Forming a dry etched, resist-profile-defined semiconductor slope right in front of and below said coupling facet;
  - d) Forming said semiconductor slope to have a tapering profile with adequate curve functions;
  - e) Coating said coupling facet with an antireflective dielectric film;
  - f) Covering said semiconductor slope with a highly reflective metal film and a thick dielectric layer followed by a planarization process;
  - g) Providing an optical funneling effect in the vertical direction with said thick dielectric layer together with its tapered bottom and planarized top; and
  - h) Forming the top view of said planarized dielectric layer into a proper funnel shape so as to provide said optical funneling effect in the lateral direction.
8. The method of claim 7, wherein said coupling facet further comprises an edge of layers which is below the absorption layer and provides optical guiding.
9. The method of claim 7, wherein said planarization process for said thick

dielectric layer is a polymer spin-on process, followed by thermal curing and overall etching-back to uniformly expose the top of said photodetector.

10. The method of claim 7, wherein said planarization process for said thick dielectric layer is a conformal deposition process, followed by dielectric polishing and overall etching-back to uniformly expose the top of said photodetector.
11. The method of claim 7, wherein said planarized dielectric layer has its top covered by highly reflective metal film or left uncovered.